

## 12.01 What is a ratio?

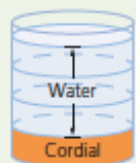
Ratios are used in a wide variety of everyday situations as a way to compare things. Lots of people use ratios: concreters, cooks, caterers and customers. Knowing about ratio, or how things change in proportion, is an important skill.



### Big ideas

A ratio is made by comparing quantities of the same kind, which must be measured in the same units. A ratio itself has no units.

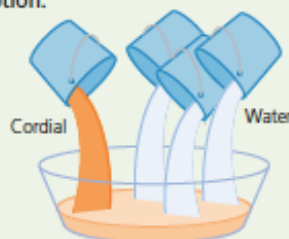
Ratios are written in a special way. For example, the ratio of cordial to water in a glass may be 1:3. This means that there is 1 part of cordial for 3 three parts of water.



We can write ratios in three different ways:

- In words: cordial to water = 1 to 3
- using a colon: cordial : water = 1 : 3
- as a fraction:  $\frac{\text{cordial}}{\text{water}} = \frac{1}{3}$

The order of numbers in a ratio is important. If the ratio of cordial to water was written as 3 : 1, this would mean 3 parts of cordial to 1 part of water. (Yuk!) It is important to keep the numbers in the same order as the word description.



The ratio is the same whether we measure by cups or by buckets.

## Worked examples 12.01 What is a ratio?

Bicycle gears are another example of ratios. The gear ratio compares the numbers of teeth (cogs) on the two gear wheels.

**WE1** This diagram shows two gear wheels in a machine. The smaller wheel has 10 teeth. The larger wheel has 13 teeth. What is the ratio of the teeth on the smaller wheel to the teeth on the larger wheel?



**a** Write the ratio using a colon.

### Think

The smaller wheel has 10 teeth and the larger wheel has 13 teeth. The number on the smaller wheel must be written first.

### Write

Small : large = 10 : 13

**b** Write the ratio as a fraction.

### Think

The number of teeth on the smaller wheel is the numerator.

### Write

$\frac{\text{Small}}{\text{Large}} = \frac{10}{13}$

The numerator is the top number of a fraction. The bottom number is called the denominator.

**WE2** The Year 7 Maths class has 15 girls and 10 boys.

**a** What is the ratio of boys to girls?

**Think**

Boys must be first in this case.

**Write**

Boys : girls = 10 : 15

**b** Write the ratio of boys to girls as a fraction in its simplest form.

**Think**

Boys must be the numerator. Simplify fractions by dividing top and bottom by the same number. 5 divides into 10 and 15.

**Write**

$$\frac{\text{Boys}}{\text{Girls}} = \frac{10}{15} = \frac{2}{3}$$

**c** What is the ratio of girls to students in the class?

**Think**

Girls must be first. Total of students in class is 10 boys + 15 girls = 25.

**Write**

$$\text{Girls : students in class} = 15 : 25 = 3 : 5$$

Write ratios with a colon, unless told otherwise.

## Exercise 12.01 What is a ratio?

- WE1** **1 a** Write each of these ratios as a fraction.  
 i 2 : 3      ii 3 : 8      iii 10 : 24      iv 20 : 36

**b** Write each of these fractions as a ratio.

- i  $\frac{2}{9}$       ii  $\frac{12}{25}$       iii  $\frac{9}{2}$       iv  $\frac{1}{24}$

- WE2** **2** In a class of 23 students there are 14 girls and nine boys.

- a** What is the ratio of girls to boys?  
**b** What is the ratio of boys to girls?  
**c** Write the ratios from parts **a** and **b** as fractions.

- WE2** **3** In a class of 25 students, there are 11 boys.

- a** How many girls are in the class?      **b** What is the ratio of girls to boys?  
**c** What is the ratio of boys to girls?      **d** What fraction of the class is girls?

- WE2** **4 a** Combine the two classes from questions **2** and **3**. How many girls and how many boys are in the combined class?

**b** What is the ratio of boys to girls?

## Applications and problem solving

- 5** Antonio is 175 cm tall, and his friend Andrew is 185 cm tall.  
**a** What is the ratio of Antonio's height to Andrew's height?  
**b** Write the ratio from part **a** as an unsimplified fraction.  
**c** Reduce the fraction from part **b** to its simplest form.
- 6** Kathy and Bana stack shelves in a supermarket. Kathy stacks 675 cans and Bana 450 cans. What is the ratio of cans stacked by Kathy to cans stacked by Bana?
- 7** The instructions on a bottle of garden insecticide say to add 2 L of water for each  $\frac{1}{2}$  L of insecticide. How much mixture does a 2 L bottle of insecticide make?

Express fractions in simplest form.



**E** Extra  
12.01

**C** Challenge  
12.01

At a birthday party there are two large pies for the birthday child and seven guests. In another room the three other people in the family share one pie.

Which group gets the most pie for each person?



Many times, getting an answer that is a number is not obvious or easy. It is often necessary to let your brain explore ideas and reasoning before you can work out an answer. It is important to be able to explain your thinking to yourself and others. This section challenges you to explain your thinking when you compare different things.



### Activity: Cordial mixtures

- Both these students are drinking cordial mixture. Do you think the mixtures are the same? Which might be weaker? Why? Discuss how you could change the concentration of the cordial mixture so that it would be acceptable.
- Test these cordial mixtures for taste:
  - 100 mL of water with 10 mL of cordial
  - 200 mL of water with 15 mL of cordial
  - 50 mL of water with 20 mL of cordial
  - 200 mL of water with 20 mL of cordial.

Explain why some taste better than others. Which of these are mixed in the same proportion?



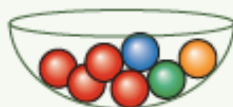
You will need: glasses, access to water, measuring devices for 10, 15, 20, 50, 100 and 200 mL and some cordial concentrate.

Use drawings, diagrams and words to explain your thinking.

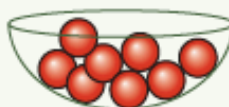
### Worked examples 12.02 Thinking in proportion

- WE1** Bowl A has red lollies and some other-colour lollies. How many other-colour lollies must be added to bowl B so that the proportion of red : other colours is the same as for bowl A?

A



B



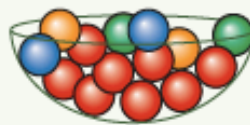


### Think

There are four red lollies and three of other colours in bowl A.  
There are eight red lollies in bowl B.  
This is double the number in bowl A ( $4 \times 2 = 8$ ), so there must be six other-colour lollies in bowl B ( $3 \times 2 = 6$ ).

### Write/Draw

Red : other colours = 4 : 3



- WE2** Mr Austin sat his Automotive class in groups of five. Each group had three boys. If the class had 25 students, how many girls and how many boys were in the class?

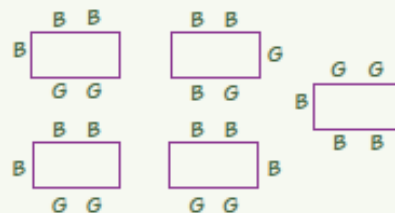
### Think

How many in the class?  
25 in class in groups of five means  
 $\frac{25}{5} = 5$  groups.  
Three boys in each group, so there must be two girls in each group.

Count the Gs and the Bs.

### Write/Draw

25 students in class



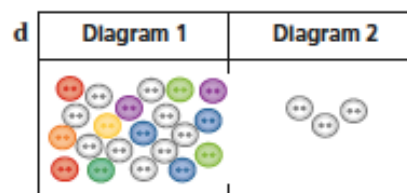
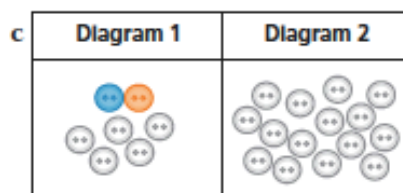
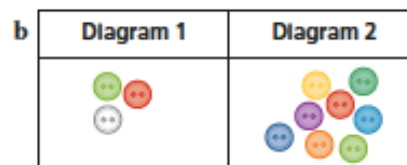
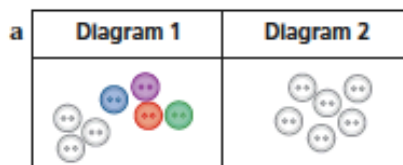
The class has 15 boys and 10 girls.

A diagram will help.



## Exercise 12.02 Thinking in proportion

- WE1** 1 Grandma's button tin holds lots of white buttons and lots of coloured buttons. In each case, draw both diagrams, then add buttons to the second diagram so that the ratio of white buttons to coloured buttons is the same as for the first diagram. Write the ratio white : coloured each time.



- WE2** 2 7F's English class sits at four tables, with three girls and two boys at each table. In Maths the class sits at two large tables, with six girls and four boys at each table.
- Draw a picture of the seating in Maths and in English for class 7F.
  - What has changed between the classes?
  - What has *not* changed between the classes?